Neurotoxicological Evaluation of Disinfection Byproducts

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Disinfection byproducts (DBPs) are chlorinated or brominated compounds produced by chlorination of drinking water, a widely used disinfection process. Previous studies have shown that DBPs are carcinogenic and teratogenic at high concentrations and are reproductive toxicants (developmentally toxic, spermatotoxic) at lower levels. Neurotoxicity has been reported in humans and laboratory animals administered high doses of dichloroacetic acid (DCA), and there are reports of neurological effects of high doses of dibromoacetic acid (DBA) and monochloroacetic acid. However, the potential for neurotoxicity following exposure to low DBP concentrations had not been specifically addressed, and DBPs of other chemical classes have not been evaluated at all. We therefore asked the following questions: 1) what is the effective DCA concentration range for producing neurotoxicity?, 2) do all DBPs produce neurotoxicity similar to that of DCA?, and 3) is the potency for neurotoxicity similar to that for reproductive toxicity? To address these questions, we conducted neurotoxicological assessments of DBPs drawn from several different chemical classes (haloacetic acids, methanes, and nitriles) using neurobehavioral and pathological evaluations. Following the positive findings obtained with DCA, additional studies were initiated in collaboration with NIEHS and integrated with ongoing NTP studies on DBPs. Our findings showed that DCA neurotoxicity is more pronounced, persistent, and occurred at lower exposures that previously reported in the literature. The severity, specificity, and recovery of neurological changes were route, duration, and strain dependent. DBA was also neurotoxic, producing both neurobehavioral changes and spinal cord axonal degeneration. Other chemicals tested included bromodichloromethane (BDCM) and dibromoacetonitrile (DBAN); these DBPs did not produce alterations in the neurological endpoints. The Safe Drinking Water Act requires EPA to consider noncancer endpoints for the assessment of adverse human health effects of DBPs. These studies demonstrate that, for the haloacetic acids, neurotoxicity should be considered in this overall evaluation.

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